60364400

CONTROL DATA CORPORATION

CDC® DISK STORAGE SUBSYSTEM

7054-1/21/41 DISK STORAGE CONTROLLERS
10285-1 DUAL CHANNEL SWITCH OPTION
10328-1 SECOND CHANNEL FEATURE
7054-2/22/42 DISK STORAGE CONTROLLERS
7654-1/21 DISK STORAGE CONTROLLERS
844-2/21/41/44 DISK STORAGE UNITS
10304-1/2 MASS STORAGE EXTENDER OPTION
10333-1 DOUBLE DENSITY OPTION
7154-1/2/3/4 DISK STORAGE CONTROLLERS
10365-1 SECOND CHANNEL FEATURE
10367-1 ADDITIONAL CHANNEL FEATURE

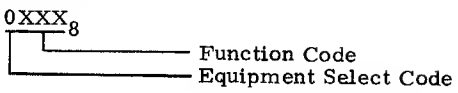
GENERAL INFORMATION MANUAL

7X54/844 PROGRAMMING INFORMATION SUMMARY

SECTOR LENGTH

502_8 (322_{10}) 12-bit words
1204_8 (644_{10}) 6-bit characters

COMMAND FORMAT



COMMANDS

Function Code	Parameter Output	Status Input	Command Name	Page
0000	1 word	-	Connect	1-5
0001	4 words	-	Seek, 1:1 Interlace	1-5
0002	4 words	-	Seek, 2:1 Interlace	1-5
0003	1 word	-	I/O Length	1-5
0004	-	-	Read	1-6
0005	-	-	Write	1-6
0006	-	-	Write Verify	1-6
0007	-	-	Read Checkword	1-6
0010	-	-	Operation Complete	1-6
0011	-	-	Disable Reserve	1-6
0012††	-	1 word	General Status	1-7
0013	-	12 words†††	Detailed Status	1-8
0014	-	-	Continue	1-13
0015	-	-	Drop Seeks	1-14
0016	7 words	-	Format Pack	1-14
0017†	-	1 word	On-Sector Status	1-16
0020††	-	-	Drive Release	1-16
0021	-	1 word†††	Return Cylinder Address	1-17
0022	1 word	-	Set/Clear Flaw	1-17
0023††	-	20 words††	Extended Detailed Status	1-8
0024††	-	-	Gap Sector - Read	1-17
0025††	-	-	Gap Sector - Write	1-17
0026††	-	-	Gap Sector - Write Verify	1-17
0027††	-	-	Gap Sector - Read Checkword	1-17
0030††	-	-	Read Factory Data	1-17
0031††	-	-	Read Utility Map	1-18
0032††	-	-	Diagnostic Read	1-18
0033††	-	-	Diagnostic Write	1-18
0034††	-	-	Read Flawed Sector	1-18
0035††	-	-	Write Last Sector	1-19
0036††	-	-	Write Verify Last Sector	1-19
0037††	-	-	Write Flawed Sector	1-19
0040††	-	-	Read Short	1-19
0041††	1 word	-	Select Strobe and Offset	1-19
0042††††	-	-	Clear Coupler Connects	1-20
0046††††	-	-	Write Buffer to Disk	1-20
0043††††	-	-	Read Coupler Buffer	1-20
03UU††	-	-	Deadstart from Disk	1-20
01UU	-	-	Load Controlware from Disk	1-20
0414	-	-	Start Memory Load	1-20

†7TPPs only
††6TPPs only
†††7TPPs must input this status on the data channel
††††7154 and 7152 DSCs only

ADDRESS FORMAT FOR SEEK COMMANDS

WORD 1	EXPANDER/DSU NUMBER
WORD 2	STARTING CYLINDER NUMBER
WORD 3	STARTING TRACK NUMBER
WORD 4	STARTING SECTOR NUMBER

GENERAL STATUS WORD

11	ABNORMAL TERMINATION
10	MULTIACCESS COUPLER RESERVED
9	NONRECOVERABLE ERROR
8	RECOVERY IN PROGRESS
7	CHECKWORD ERROR
6	CORRECTABLE ADDRESS ERROR
5	CORRECTABLE DATA ERROR
4	DSU MALFUNCTION
3	DSU RESERVED
2	MISCELLANEOUS ERROR
1	BUSY
0	NONCORRECTABLE DATA ERROR

60364400

CONTROL DATA CORPORATION

CDC® DISK STORAGE SUBSYSTEM

7054-1/21/41 DISK STORAGE CONTROLLERS
10285-1 DUAL CHANNEL SWITCH OPTION
10328-1 SECOND CHANNEL FEATURE
7054-2/22/42 DISK STORAGE CONTROLLERS
7654-1/21 DISK STORAGE CONTROLLERS
844-2/21/41/44 DISK STORAGE UNITS
10304-1/2 MASS STORAGE EXTENDER OPTION
10333-1 DOUBLE DENSITY OPTION
7154-1/2/3/4 DISK STORAGE CONTROLLERS
10365-1 SECOND CHANNEL FEATURE
10367-1 ADDITIONAL CHANNEL FEATURE

GENERAL INFORMATION MANUAL

REVISION RECORD

REVISION	DESCRIPTION
01	Review draft circulated
(6-15-72)	
02	Preliminary manual
(7-15-72)	
A	Manual released
(8-31-72)	
B	Manual revised; Engineering Change Order 33900. Cover, title page, and pages v, 2-1, 2-2, 3-1,
(6-5-73)	4-2, 4-3, 4-4 are revised. Page 1-5 is added.
C	Manual includes Engineering Change Order 35406. This edition obsoletes all previous editions.
(7-17-74)	
D	Manual revised; includes Engineering Change Order 36247 (publications change only). This
(3-31-75)	edition obsoletes all previous editions.
E	Manual revised; includes Engineering Change Order 37490. This edition obsoletes all previous
(12-30-76)	editions.
F	Engineering Change Order 41203. To release microfiche at this revision level. No change to
(5-8-80)	hardcopy.
G	Manual revised; includes Engineering Change Order 43502. Grid locator 171B4 (iii/iv) is re-
(04-21-82)	vised.

Publication No.
60364400

REVISION LETTERS I, O, Q, S, X, AND Z ARE NOT USED

Address comments concerning this manual to:

Control Data Corporation
Publications and Graphics Division
4201 North Lexington Avenue
St. Paul, Minnesota 55112

or use Comment Sheet in the back of this manual.

PREFACE

This manual describes the general characteristics of CONTROL DATA Disk Storage Subsystems using one or more CONTROL DATA® 7X54 Series Disk Storage Controllers (DSC) and 844 Series Disk Storage Units (DSU).

This manual contains a general description of each disk storage subsystem product, physical characteristics of each product, characteristics of 7X54/844 subsystems, and a brief overview of subsystem hardware and software.

The reader is assumed to be familiar with the input/output (I/O) channel characteristics of one or more of the following CDC computer systems.

6000 Series
CYBER 70, Models 72, 73, 74
7000 Series
CYBER 70, Model 76
CYBER 170, Models 172, 173, 174, 175

The Disk Storage Subsystem Operation and Programming Manual, Publication No. 60363900, gives computer system programming information and disk storage subsystem operating procedures. The reader may wish to reference the following manuals for computer system I/O channel requirements.

CDC Publication	Publication Number
CDC CYBER 70, Model 72/73/74 I/O Specifications (applies to 6000 series also)	60352500
CDC CYBER 170 I/O Specifications	19983600
CDC 7600/CYBER 70, Model 76 Hardware Reference Manual	60367200

WARNING

This equipment generates, uses and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. As temporarily permitted by regulation, it has not been tested for compliance with the limits for Class A computing devices pursuant to Subpart J of Part 15 of the FCC Rules which are designed to provide reasonable protection against such interference. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

CONTENTS

FIGURES

TABLES

GENERAL DESCRIPTION 1

INTRODUCTION

The disk storage subsystems described in this manual provide high-speed, random-access mass storage for large computer systems. A subsystem consists of one or more 7X54 series DSCs and a minimum of two 844 DSUs.

This section gives a brief description of the individual products used in these subsystems. Section 3 describes the interaction of these products in a subsystem environment.

7X54 SERIES DISK STORAGE CONTROLLERS

Each of these devices consists of a programmable disk controller, its associated controlware (nonalterable software), and a coupler. The controlware determines the characteristics of the disk controller, while the coupler interfaces the disk controller with a higher level processor (HLP).

The following paragraphs describe available DSCs in the 7X54 series. Figure 1-1 illustrates how the 7X54 series DSCs interface the 844 DSUs with the HLP I/O channels. Table 1-1 summarizes the characteristics of each controller.

7054-1 DISK STORAGE CONTROLLER

This controller interfaces from two to eight 844-2 and/or 844-21 DSUs with one standard I/O channel from a CDC 6000 series or CDC CYBER 70, model 72, 73, or 74 computer system. The 10285-1 Dual Channel Switch Option converts a single channel 7054-1 controller to a dual channel 7054-2 controller.

7054-21 DISK STORAGE CONTROLLER

This controller interfaces from two to eight 844-2 and/or 844-21 DSUs with one standard I/O channel from a CDC 6000 series or CDC CYBER 70, model 72, 73, or 74, or CDC CYBER 170 model, 172, 173, 174, or 175 computer system. The only functional difference between the 7054-1 and the 7054-21 is that the model 21 checks parity on the CDC CYBER 170, model 172, 173, 174, or 175 I/O channel. The 10328-1 second channel feature converts a single channel 7054-21 to a dual channel 7054-22 controller.

7054-2 DISK STORAGE CONTROLLER

This controller interfaces from two to eight 844-2 and/or 844-21 DSUs with two standard I/O channels from a CDC 6000 series or CDC CYBER 70, model 72, 73, or 74 computer system. The 7054-2 serves the I/O channels on a one-at-a-time basis. I/O channels may be from the same or from different computer systems.

7054-22 DISK STORAGE CONTROLLER

This controller interfaces from two to eight 844-2 and/or 844-21 DSUs with two standard I/O channels from a CDC 6000 series or CDC CYBER 70, model 72, 73, or 74, CDC CYBER 170 model, 172, 173, 174, or 175 computer system. The only functional difference between the 7054-2 and the 7054-22 is that the model 22 checks parity on the CDC CYBER 170, model 172, 173, 174, or 175 I/O channel.

7054-41 DISK STORAGE CONTROLLER
7054-42 DISK STORAGE CONTROLLER

This controller interfaces from two to eight 844-2/21/41/44 DSUs, in any combination, with one standard I/O channel from a CDC 6000 series; CDC CYBER 70, model 72, 73, or 74 computer system; or CDC CYBER 170, model 172, 173, 174, or 175 computer system. The 7054-41 is the same as 7054-1/21 controllers, except it contains the 10333-1 Double Density Option to permit operation with double density 844-41 DSUs. The 10328-1 second channel feature converts a single channel 7054-41 to a dual channel 7054-42 controller.

7154-1/2/3/4 DISK STORAGE CONTROLLERS

The 7154 series controllers interface from two to eight 844-2/21/41/44 DSUs, in any combination, with standard I/O channels from CDC 6000 series; CDC CYBER 70, models 72, 73, or 74 computer system; or CDC CYBER 170 Series Computer Systems. These controllers allow system transfers at 1:1 interlace (full tracking) on a CDC CYBER 170 channel.

Up to four HLP channel accesses are available on 7154 controllers. The last digit of the model number indicates the number of accesses (for example, the 7154-4 permits access to four HLP channels). Additional accesses are available as options to increase the number of accesses on models 7154-1, 7154-2, or 7154-3. Option 10365-1 provides

a second channel connection to a 7154-1 making the controller equivalent to a 7154-2. Option 10367-1 provides additional channel connections to 7154-2 or 7154-3. Two 10367-1 options may be added to the 7154-2 and one option may be added to the 7154-1 providing a maximum of four accesses.

The subsystem processor memory used in the 7154 is a semiconductor memory rather than the core memory used in earlier 7X54 controllers. Although the two types of memories are different internally, they are similar from the standpoint of subsystem function. A factory installed modification is available to convert earlier 7X54 controllers to 7154 controllers; these modified products will retain the core memory.

7654-1 DISK STORAGE CONTROLLER
7654-21 DISK STORAGE CONTROLLER

Either controller interfaces from two to eight 844-2 and/or 844-21 DSUs with two pairs of I/O channels from a CDC 7000 series or CDC CYBER 70, Model 76 computer system. As illustrated in Figure 1-1, each computer system access of the 7654-1/21 requires two I/O channels. The 7654-1/21 serves each pair of I/O channels on a one-at-a-time basis. I/O channel pairs may be from the same or different computer systems. The 7654-1 and 7654-21 are functionally identical.

844-2 DISK STORAGE UNIT
844-21 DISK STORAGE UNIT
844-41 DISK STORAGE UNIT
844-44 DISK STORAGE UNIT

The 844 Disk Storage Units transfer data between the DSC and the disk pack. Models 844-2/21/41 have two DSC accesses, and the 844-44 has four DSC accesses. When more than one DSC is connected to the same DSU, the DSU serves the controllers on a one-at-a-time basis. The 844-2/21 DSUs use the CDC model 881 disk pack, and the 844-41/44 DSUs use the CDC 883 (double density) disk pack.

All models of the 844 contain a spindle to accept the disk pack, an electromagnetically positioned head assembly, and electronics for head positioning and data transfers. All models are functionally identical.

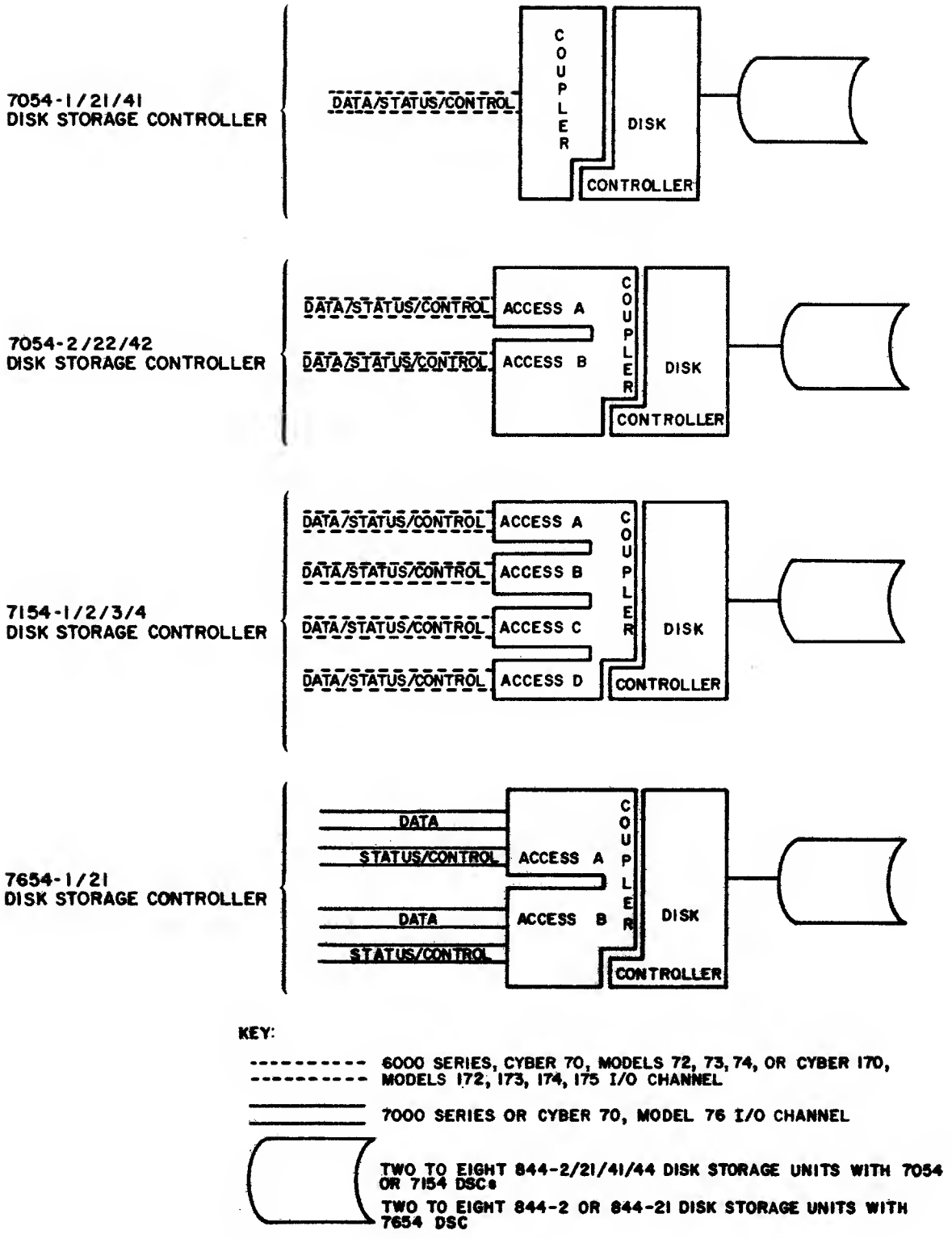


Figure 1-1. 7X54 Series Disk Storage Controllers

TABLE 1-1. 7X54 SERIES DISK STORAGE CONTROLLER SUMMARY

Controller	Computer Accesses	Mainframe Interfaces	Disk Pack Characteristics		Controller Determined Disk Pack Parameters			Disk Storage Units Per Controller	
			Tracks Per Cylinder	Cylinders Per Pack	Bits Per Character	Characters Per Sector	Sectors Per Track	Minimum	Maximum
7054-1	1	6000 series, CYBER 70 models 72,73, and 74	19	404 (plus 7 spares)	6	644	24	2	8
7054-2	2								
7054-21	1	6000 series, CYBER 70 models 72,73, and 74, CYBER 170 series							
7054-22	2								
7054-41	1		19	808 (plus 15 spares)	6	644	24	2	8
7054-42	2								
7154-1	1		19	404 (plus 7 spares) or 808 (plus 15 spares)	6	644	24	2	8
7154-2	2								
7154-3	3								
7154-4	4								
7654-1 7654-21	2	7000 series, CYBER 70 model 76	19	404 (plus 7 spares)	6	644	24	2	8

STANDARD OPTIONS 10304-1 AND 10304-2 MASS STORAGE EXTENDERS

The number of drives which can be attached to each disk controller can be increased by adding Standard Options 10304-1 and 10304-2 Mass Storage Extenders to the 7054 configuration. Standard Option 10304-1 increases the maximum number of drives attached to a controller to 22. Standard Option 10304-2 increases the maximum to 36. Standard Option 10304-2 cannot be installed without Standard Option 10304-1. By adding two 10304-1's and two 10304-2's each controller can handle a maximum of 64 drives. Figure 1-2 illustrates a configuration with a 10304-1 and a 10304-2 in the system.

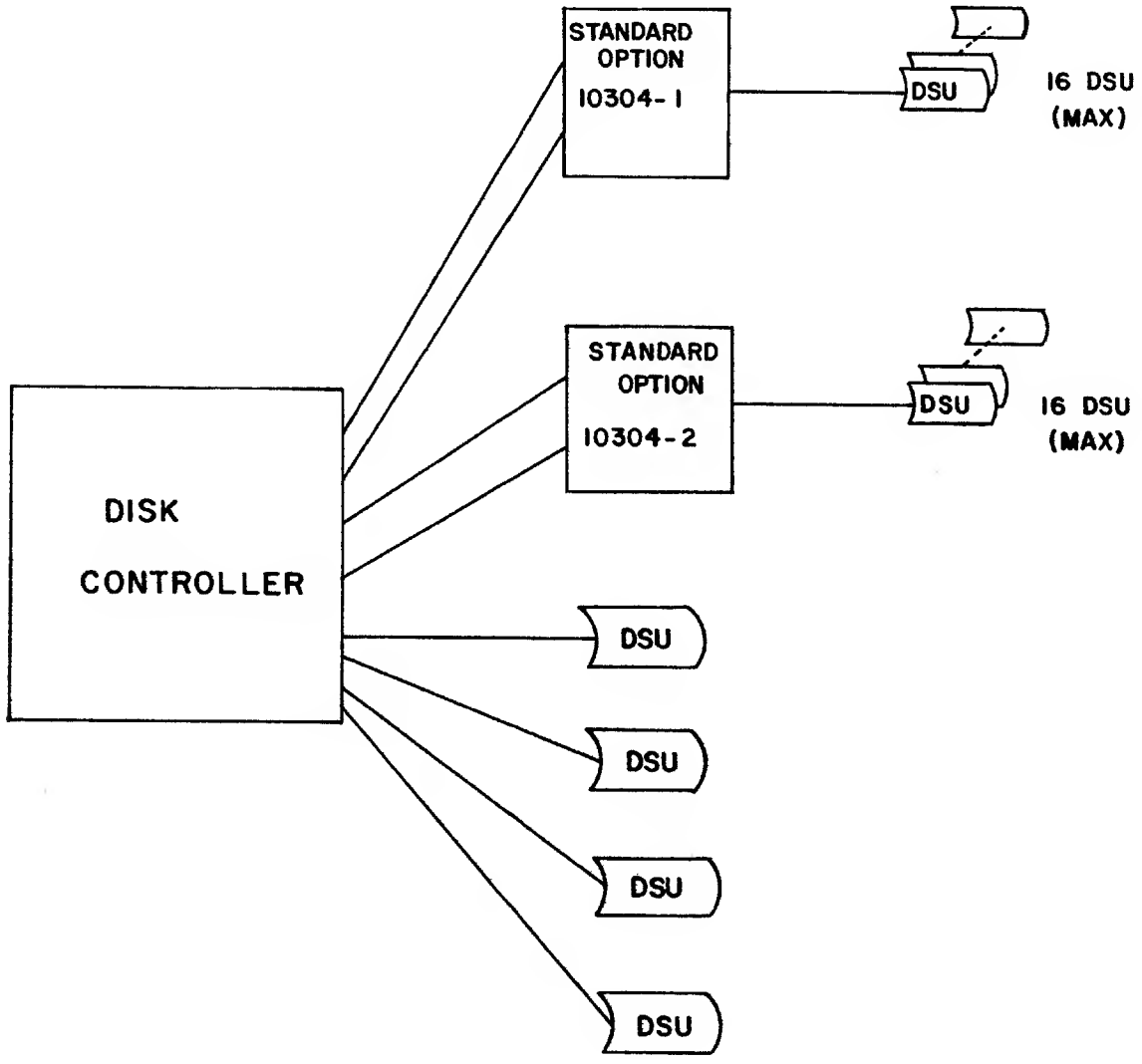


Figure 1-2. Configuration with Standard Options (Maximum Number of DSUs)

PHYSICAL CHARACTERISTICS 2

Tables 2-1, 2-2, and 2-3 give physical, electrical, and environmental information, respectively, for disk storage subsystem products. Figures 2-1, 2-2, and 2-3 illustrate the various models of DSCs and DSUs.

TABLE 2-1. PRODUCT PHYSICAL CHARACTERISTICS

Product	Height		Width		Depth		Outside Diameter		Weight	
	In.	Cm	In.	Cm	In.	Cm	In.	Cm	Lb	Kg
7054-1/2 7654-1	76	193	39	99	30	76	N/A	N/A	600	272
7054-21/41 7054-22/42 7654-21	76	193	29.3	74.4	25	63.5	N/A	N/A	300	136
7154-1/2/3/4	76	193	29.3	74.4	25	63.5	N/A	N/A	300	136
844-2	38	96	22	57	49	124	N/A	N/A	700	315
844-21/41/44	39.5	100.3	22	57	44	111.8	N/A	N/A	700	315
881/883 (with cover)	6.75	17.1	N/A	N/A	N/A	N/A	15	38	20	9.1
St. Op. 10304-1 10304-2	76 -	193 -	29.3 -	74.4 -	25 -	63.5 -	N/A -	N/A -	750 50	340 23

TABLE 2-2. PRODUCT ELECTRICAL DATA†

Product	AC Voltage	Hz Freq.	Phase	Phases Used	Amp/Phase		KVA	KW	Power Factor
					Run	Start			
7054-1 7054-2 7654-1	120/208	400	3	3	2.0	N/A	0.61	0.57	0.93
	120	60	1	1	4.16	5 sec @17	0.50	0.46	0.92
	(220)	(50)	(1)	(1)	(2.45)	-	(0.55)	(0.44)	(0.80)
844-2	120/208	60	3	2	8	7 sec @42	1.7	1.2	0.70
	(220)	(50)	(3)	(1)	-	-	-	-	-
844-21	208	60	3	3	6.5	7 sec @45	1.35	1.1	0.82
	(220)	(50)	(3)	(3)	(7.5)	-	(1.65)	(1.2)	(0.73)
St. Op. 10304-1 and 10403-2††	120/208	400	3	3	1.5	-	0.51	0.53	0.96
	120	60	1	1	1.3	N/A	0.137	0.156	0.88
	(220)	(50)	(1)	(1)	-	-	-	-	-
7054-21/41 7054-22/42 7654-21 7154-1/2/3/4	120/208	400	3	3	1.8	-	0.64	0.62	0.97
	120	60	1	1	1.1	-	0.13	0.10	0.77
	(220)	(50)	(1)	(1)	(0.55)	-	(0.13)	(0.10)	(0.77)
844-41/44	208	400	3	3	1.5	-	-	-	-
	208	60	3	3	6.0	10 sec @37	1.35	1.1	0.70
	(220)	(50)	(3)	(3)	(7.0)		(1.65)	(1.2)	(0.59)

†Entries in parentheses apply to 50-Hz models only.
††Both housed in same cabinet.

TABLE 2-3. PRODUCT ENVIRONMENTAL CHARACTERISTICS

Nonoperating						
Product	Temperature		Relative Humidity		Altitude	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
7054-21/41 7054-22/42 7654-21	-30°F -34°C	150°F 66°C	5%	95%	-	-
7054-1/2 7654-1	-30°F -34°C	150°F 66°C	5%	95%	-	-
7154-1/2/3/4	-40°F -40°C	150°F 66°C	5%	95%	-	-
Sp. Op. 10304-1 and 10304-2	-30°F -34°C	150°F 66°C	5%	95%	-	-
844-2/21	-30°F -34°C	150°F 66°C	5%	95%	-1000 ft - 305 m	15000 ft 4.6 Km
844-41/44	-40°F -40°C	158°F 70°C	5%	95%	- 980 ft - 299 m	8200 ft 2.5 Km

Operating									
Product	Temperature				Relative Humidity		Altitude		Heat Dissipation
	Minimum	Nominal	Maximum	Maximum Gradient	Minimum	Maximum	Minimum	Maximum	
7054-21/41 7054-22/42 7654-21	59°F 15°C	75°F 24°C	90°F 32°C	9°F/hr 5°C/hr	35%	60%	-	-	5000 Btu/hr 1465 Watts
7054-1/2 7654-1	40°F 4°C	75°F 24°C	120°F 49°C	20°F/hr 11°C/hr	10%	90%	-	6000 ft 1.83 Km	5600 Btu/hr 1641 Watts
7154-1/2/3/4	59°F 15°C	75°F 24°C	90°F 32°C	9°F/hr 5°C/hr	35%	60%	-	-	2750 Btu/hr 806 Watts
Sp. Op. 10304-1 and 10304-2	40°F 4°C	75°F 24°C	120°F 49°C	20°F/hr 11°C/hr	10%	90%	-	6000 ft 1.83 Km	5000 Btu/hr 1465 Watts
844-2/21	59°F 15°C	75°F 24°C	90°F 32°C	12°F/hr 7°C/hr	20%	80%	-1000 ft -305m	6000 ft 1.83 Km	4500 Btu/hr 1319 Watts
844-41/44	59°F 15°C	75°F 24°C	90°F 32°C	9°F/hr 5°C/hr	35%	60%	- 980 ft - 299 m	9850 ft 3.0 Km	4500 Btu/hr 1319 Watts

Figure 2-1. 7054-1/2 or 7654-1 Disk Storage Controller

Figure 2-2. 844-2 Disk Storage Unit

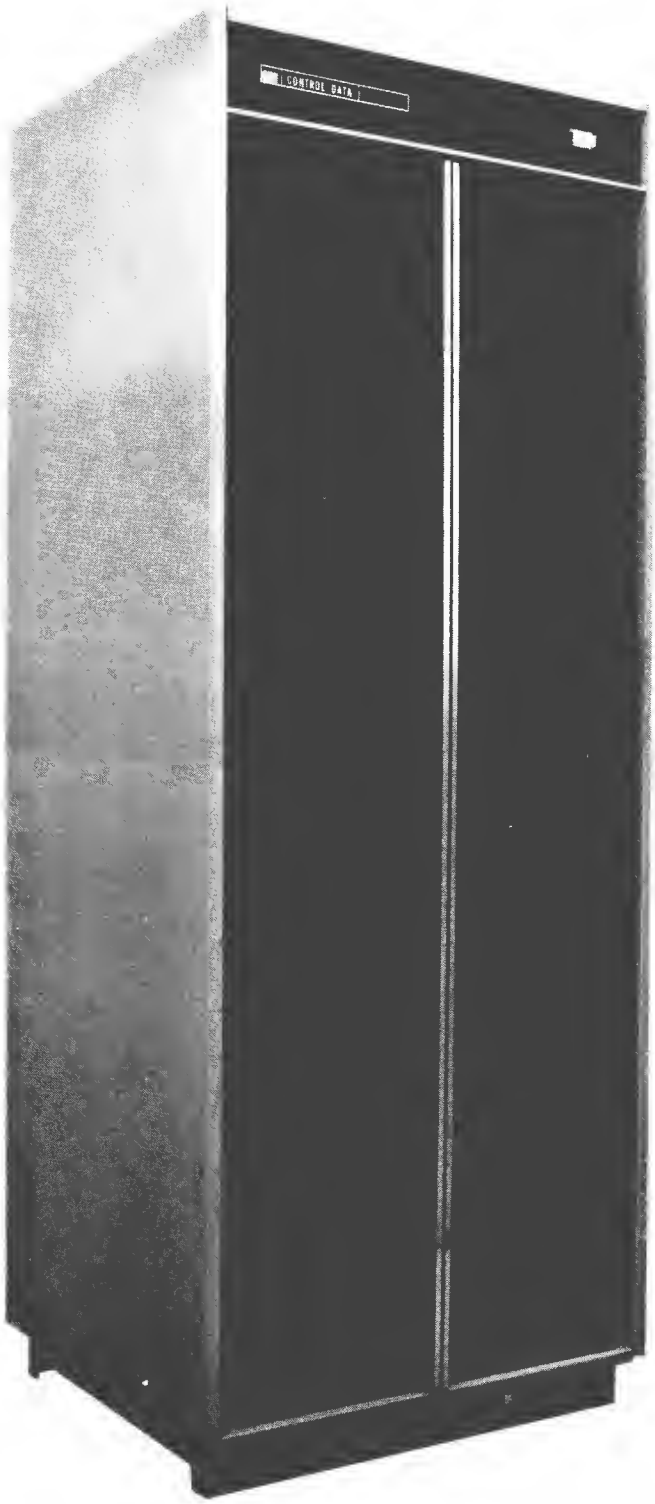


Figure 2-3. 7054-21/22/41/42, 7154-1/2/3/4, or 7654-21 Disk Storage Controller

Figure 2-4. 844-21/41/44 Disk Storage Unit

SUBSYSTEM CHARACTERISTICS 3

SUBSYSTEM CONFIGURATION

The multiaccess capabilities of some 7X54 series DSCs and all 844-2/21/41/44 DSUs provide two dimensions of flexibility in disk storage subsystem planning. In addition, the multiple I/O channel/processor characteristics of CDC large computer systems allow a third dimension of flexibility. These factors permit a systems planner to specify a disk storage subsystem that best meets the requirements of a computer system. Figure 3-1 illustrates several possible subsystem configurations.

A minimum disk storage subsystem (Figure 3-1a) consists of one DSC driving two DSUs; the subsystem uses only one access of the DSC and of each DSU. The minimum subsystem provides a single data path between one HLP I/O channel and the selected DSU. As computer system requirements become more complex, however, the accessibility, reliability, and capacity of a disk storage subsystem can be selectively increased.

- Multiaccess DSCs provide increased accessibility to common DSUs (Figure 3-1c) or to a combination of common DSUs and single DSC-dedicated DSUs (Figure 3-1d).
- Dual access DSUs increase subsystem reliability by providing independent paths to disk storage through two DSCs (Figures 3-1b and 3-1d).
- Subsystem capacity can be increased with additional DSUs. Each standard DSC can connect to a maximum of eight DSUs. The addition of two Standard Option 10304-1's and two 10304-2's increases the maximum number of DSUs to 64. (The 844-41 DSUs cannot connect to these standard options but may connect to the same controller that is using these standard options for 844-2/21 DSUs.)

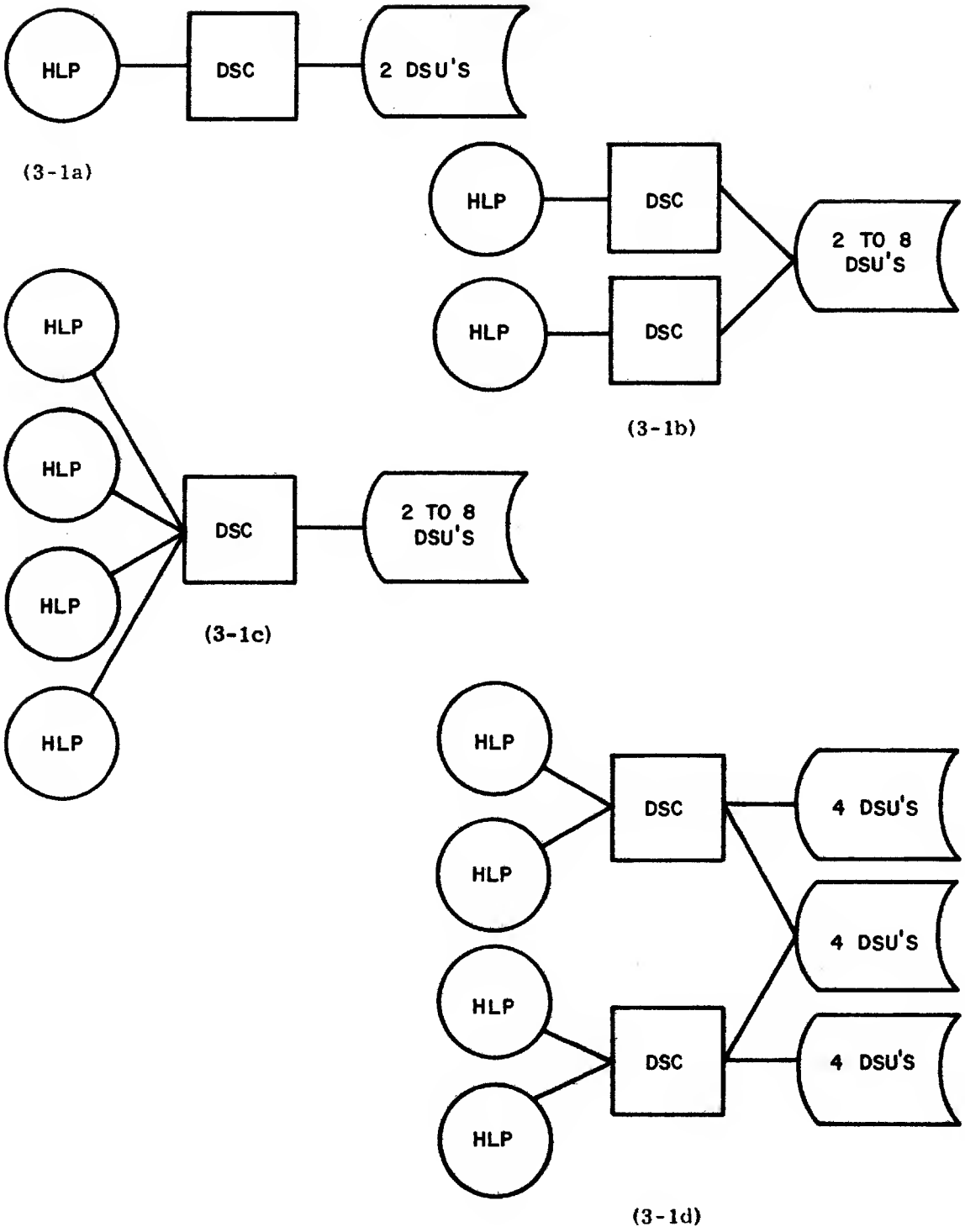


Figure 3-1. Disk Storage Subsystem Configuration

SUBSYSTEM PERFORMANCE

Table 3-1 gives disk storage subsystem data capacity, access time, and transfer rate. The following paragraphs clarify entries in Table 3-1.

TABLE 3-1. DISK STORAGE SUBSYSTEM PERFORMANCE SUMMARY

Data Capacity (6-bit characters)			
Per Sector	Per Track	Per Cylinder	Per Disk Pack
644	15,456	293,664	118,640,256 †

Access Time (milliseconds)				
Random Seek		Cylinder to Cylinder	Rotational Latency	
Maximum	Average	Average	Maximum	Average
55	30	10	16.7	8.3

Transfer Rate (millions of 6-bit characters per second)		
Single Sector Maximum	Large Block Nominal	
	1:1 Interlace	2:1 Interlace
1.13 ††	0.925	0.462

† 237,280,512 for 844-41 only.
†† 1.08 for 844-41 only.

DATA ORGANIZATION

Information on a disk pack is divided into cylinders, tracks, and sectors as illustrated in Figure 3-2.

A cylinder consists of all the information accessible by all heads in one position. It includes one track for each recorded disk surface in the pack.

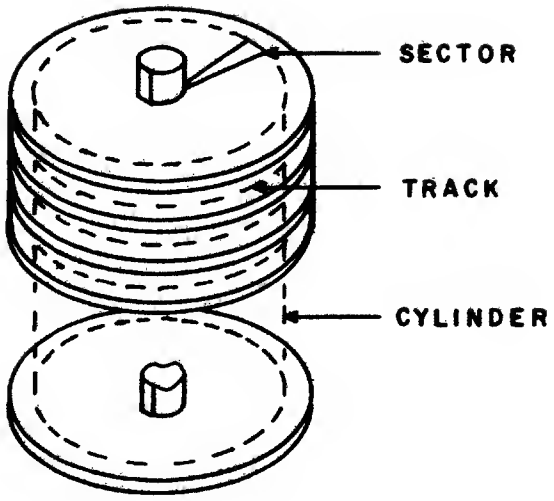


Figure 3-2. Disk Pack Information Divisions

A track consists of all the information accessible by one head in one position. A track is further divided into sectors.

A sector is the smallest addressable area on a disk pack.

DATA CAPACITY

The on-line data capacity of a disk storage subsystem depends upon the number of DSUs in the facility and also upon DSC-determined sector parameters. Each DSC in the 7X54 series drives from two to eight DSUs and specifies a sector length of 644 6-bit characters.

ACCESS TIME

Access time is the time a DSU requires to locate the addressed sector. Before transferring data, a DSU moves the heads to a cylinder and selects one of the data heads. The selected head then transfers data as the appropriate sector passes under (or over) it. Thus, total access time consists of the time required for head movement plus

time spent waiting for the appropriate sector to reach the selected head (rotational latency). Head select time is negligible.

DATA TRANSFER RATE

The single sector maximum transfer rate (Table 3-1) is the maximum rate at which one sector of data can be transferred.

The large block nominal rates are the average rates at which from two to 456 sectors (on the same cylinder) can be transferred. Both large block rates take into account facility overhead time required for addressing, error checking, and so on. The 2:1 interlace transfer rate is half the 1:1 interlace rate, since the 2:1 mode transfers only half the sectors on a track per disk revolution.

SUBSYSTEM/HLP COMMUNICATION

HLP COMMANDS

An HLP uses 12-bit commands to initiate activity within a disk storage subsystem. For some commands, a parameter array (consisting of from one to seven 12-bit words) provides additional information related to the command.

SUBSYSTEM STATUS

General and detailed status request procedures permit an HLP to determine the status of a subsystem. A subsystem returns a 12-bit word to an HLP in response to a general status request. In response to a detailed status request, a subsystem returns a status block of twelve or twenty 12-bit words.

COMMAND TYPES

A subsystem responds to the following types of commands from an HLP. (For specific information concerning subsystem commands, refer to the operation and programming manual listed in the preface.)

Autoload DSC controlware

Initialize disk packs

Initiate head movement

Specify I/O length

Read

Write

Request status

Control error recovery

Verify data already written

COMMAND OVERLAP

An HLP can minimize the average access time for a subsystem by initiating head movement (if necessary) on multiple DSUs and then transferring data with the first DSU to reach its addressed sector. The remaining DSUs continue their accessing activity during the data transfer. When the first transfer is complete, the HLP may then elect to transfer data with the next DSU to achieve on-sector status.

ERROR DETECTION/RECOVERY

A DSC monitors all data transfer operations for errors in sector address fields or errors in sector data fields. When the DSC determines that a sector address error is correctable, it corrects the error. When the DSC determines that a sector address error is not correctable, it provides the appropriate status to the HLP. The HLP can then attempt recovery by commanding the DSC to adjust head positioner offset and/or data strobe in the addressed DSU.

The DSC handles errors in sector data fields in a similar manner, except for correctable errors during read operations. When the DSC detects this type of error, it provides correction information to the HLP. The HLP then uses the correction information to modify the sector just read.

HARDWARE OVERVIEW 4

7X54 SERIES DISK STORAGE CONTROLLERS

Figure 4-1 illustrates the major hardware components of controllers in the 7X54 series. The components include a coupler, a subsystem processor, control logic with memory scanner, and a semiconductor (or core) memory.

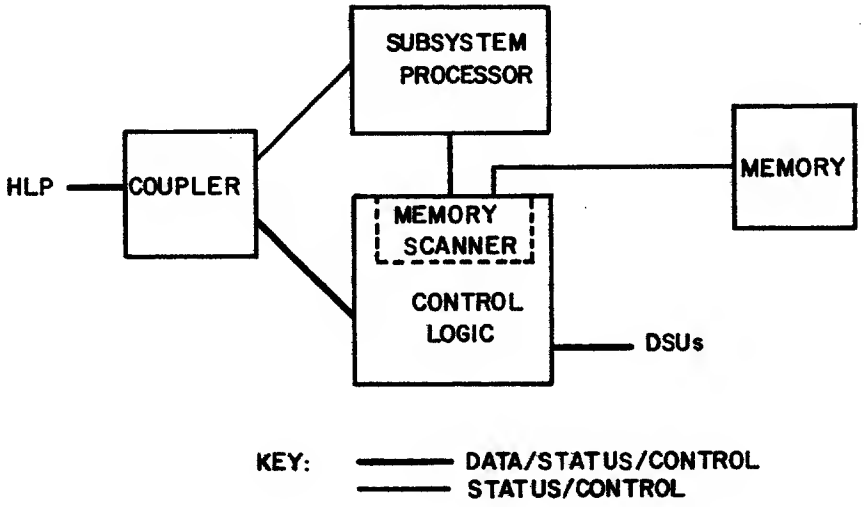


Figure 4-1. Disk Storage Controller Hardware Components

COUPLER

The coupler provides an interface between an HLP and either the subsystem processor or the control logic. It also checks for valid subsystem commands and performs assembly/disassembly to match 12-bit words from the HLP with 16-bit words used in the DSC.

Couplers in 7054-1/21/41 (single channel), 7054-2/22/42 (dual channel), and 7154-1/2/3/4 (multiaccess) DSCs interface with I/O channels from CDC 6000 series or CDC CYBER 70, models 72, 73, or 74 computer system. Couplers in 7054-21/41, 7054-22/42, and

7154-1/2/3/4 DSCs also interface with CDC CYBER 170 computer systems. The coupler in a 7654-1 and 7654-21 DSC provides dual access to a subsystem for CDC 7000 series or CDC CYBER 70, model 76 computer system.

SUBSYSTEM PROCESSOR

This 16-bit processor provides executive control for the DSC. It uses controlware stored in memory to handle HLP communication and to select director routines (control logic software) for execution by the control logic. Although the subsystem processor determines when and how data is transferred, it does not perform data transfer operations.

CONTROL LOGIC

This element controls DSU physical activity, transfers data between the coupler and a DSU, and handles error detection/correction. It performs these functions by executing director routines stored in subsystem processor memory.

MEMORY SCANNER

The memory scanner functions as a 2X1 switch to permit the subsystem processor and the control logic to share memory. In addition, this scanner assigns highest access priority to real-time related control logic requests so that these requests are honored without delay.

MEMORY

This 4096-word 16-bit per word memory stores controlware for the subsystem processor and the control logic. Later 7154 series DSCs use a semiconductor memory; earlier 7154 models and all other model DSCs use a core memory. Although the two memories are different physically, they are similar from the standpoint of subsystem function.

SPECIAL OPTIONS 10304-1 AND 10304-2 MASS STORAGE EXTENDERS

The special options serve as an additional multiplexer/demultiplexer to allow the systems to handle additional DSUs. Each option contains two identical elements which connect to a maximum of 8 DSUs. The elements do not change the hardware interface characteristics between the controller and the DSUs.

844-2 DISK STORAGE UNIT
844-21 DISK STORAGE UNIT
844-41 DISK STORAGE UNIT
844-44 DISK STORAGE UNIT

As illustrated in Figure 4-2, the major hardware components of a DSU are a dual access switch, read/write/head select logic, a head positioner mechanism, data and servo heads, and a spindle/motor mechanism. The 844-2/21/41/44 are functionally identical.

DUAL ACCESS SWITCH

This element permits two DSCs to access the DSU on a one-at-a-time basis. In subsystems with a single DSC, only one of the accesses is used.

READ/WRITE/HEAD SELECT LOGIC

During read operations, this logic selects one of the 19 data heads for data transfer, converts analog signals from the selected head to digital information, and sends the digital information to the requesting DSC. During write operations, the logic selects a head, erases old data from the disk pack, converts digital signals from the requesting processor to analog information, and finally writes the analog information on the disk pack.

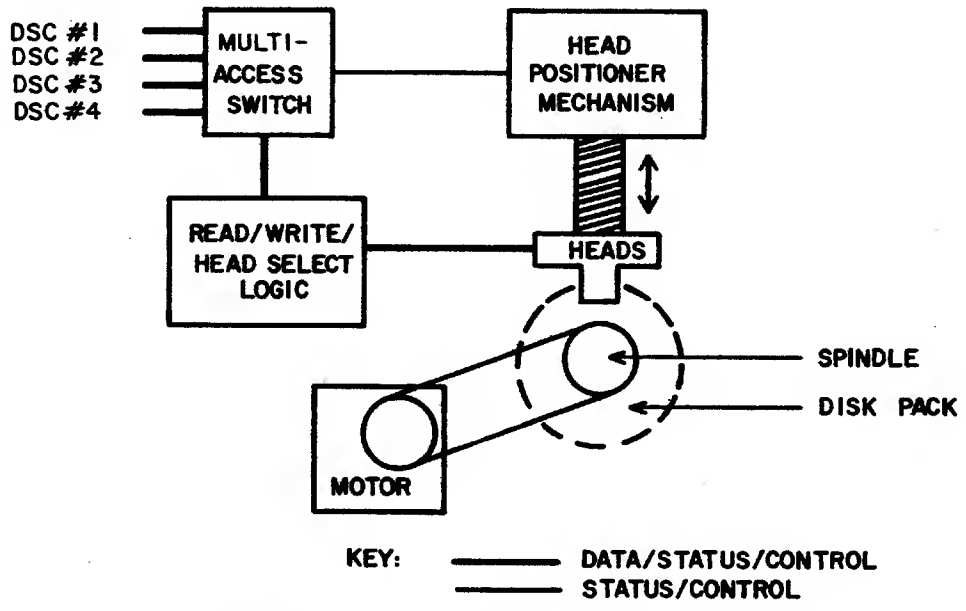


Figure 4-2. Disk Storage Unit Components

HEAD POSITIONER MECHANISM

This mechanism positions the heads with a voice coil linear actuator controlled by a closed-loop, continuous feedback servo system.

HEADS

A DSU has one read/write/erase head for each of the 19 data recording surfaces of a disk pack. An additional head monitors the servo track surface to control the voice coil actuator. All heads are combined in a single assembly and positioned simultaneously by the head positioner mechanism.

SPINDLE/MOTOR MECHANISM

An electric motor drives the spindle assembly (which mounts the disk pack) at 3600 rpm.

SOFTWARE OVERVIEW 5

INTRODUCTION

Programs resident in the subsystem processor memory of 7X54 series DSCs process commands and control hardware functions. This section briefly describes these programs, which together comprise 7X54 controlware. Figure 5-1 is a simplified block diagram showing program relationship. There are three versions of controlware for 7X54 DSCs: MA401 for 7154, MA710 for 7054, and MA720 for 7654.

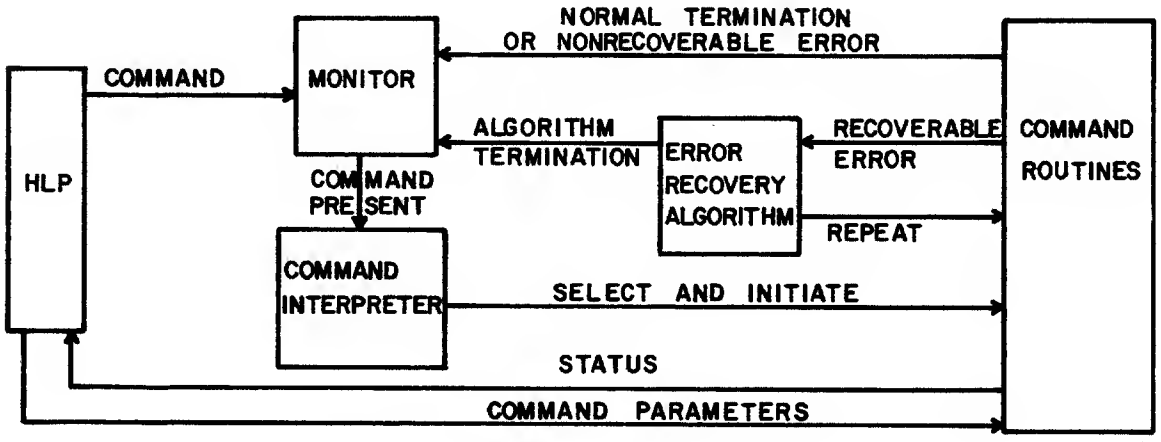


Figure 5-1. Controlware Block Diagram

MONITOR

The monitor loops until a command is present on the I/O channel from the HLP and then informs the command interpreter to decode the command and to initiate command processing.

COMMAND INTERPRETER

The command interpreter inputs a command, checks for a valid command code, and then transfers control to the appropriate command routine.

COMMAND ROUTINES

Command routines control DSC activity during processing of a particular operation. When a command routine terminates normally or a nonrecoverable error occurs, control is returned to the monitor. Otherwise, a command routine transfers control to the error recovery algorithm.

ERROR RECOVERY ALGORITHM

The error recovery algorithm generates correction vectors for some errors and controls DSC recovery from other errors. For an address field burst of 8 bits† or less, the algorithm generates a correction vector and modifies the defective address. For a data field burst error of 8 bits† or less, the algorithm supplies a correction vector and an error location to the HLP. The HLP can then use the vector and location information to modify data already read. For other errors, the algorithm (under control of continue commands from the HLP) repeats the operation using different head offset and data strobe settings. The algorithm returns control to the monitor after successful completion of the operation or after determining that the error is catastrophic.

† Eleven bits for 7654 DSCs and 7054 DSCs without the double density option.

COMMENT SHEET

MANUAL TITLE: CDC Disk Storage Subsystem
General Information Manual
PUBLICATION NO.: 60364400 **REVISION:** G

NAME: _____

COMPANY: _____

STREET ADDRESS: _____

CITY: _____ **STATE:** _____ **ZIP CODE:** _____

This form is not intended to be used as an order blank. Control Data Corporation welcomes your evaluation of this manual. Please indicate any errors, suggested additions or deletions, or general comments below (please include page number references).

☐ **Please Reply** ☐ **No Reply Necessary**

NO POSTAGE STAMP NECESSARY IF MAILED IN U.S.A.

CUT ALONG LINE

AA3419 REV. 4/79 PRINTED IN U.S.A.

FOLD FOLD

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO. 8241 MINNEAPOLIS, MINN.

POSTAGE WILL BE PAID BY

CONTROL DATA CORPORATION

Publications and Graphics Division
ARH219
4201 North Lexington Avenue
Saint Paul, Minnesota 55112

CUT ALONG LINE

FOLD FOLD